

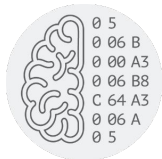


# Computational creativity and law: some results from novel concept generation

Lonneke van der Plas, Idiap

*Joint work with Inga Lang and Prajit Dhar*

29.3.2022



# Who am I?

AI researcher > specialized in  
language-related tasks > NLP

Currently leading the Computation, Cognition & Language Group  
at Idiap in Martigny

MPhil University of Cambridge

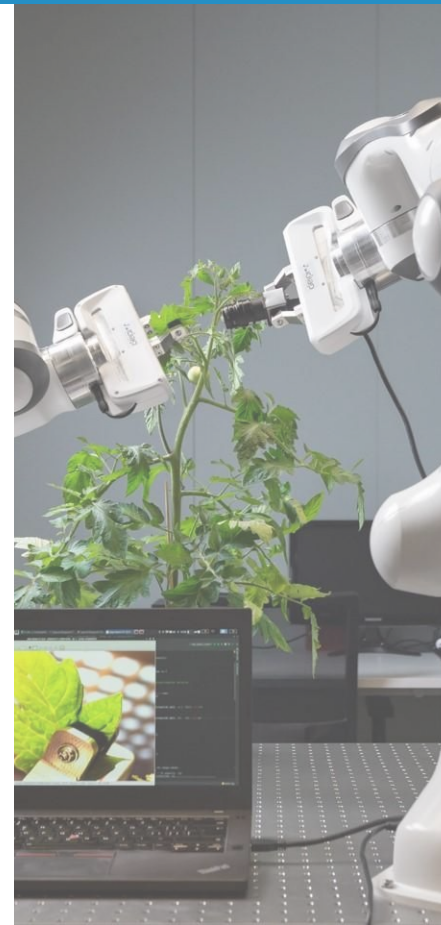
PhD University of Groningen

Junior Professorship  
University of Stuttgart

Postdoc University of Geneva

Associate Prof. University of Malta

- Independent not-for-profit Research Foundation, created in 1991
- A dedicated R&D engineers team bridging the gap between academia and industry
- Master in Artificial Intelligence □ a business integrated university training program





## Expertise

Signal Processing  
Computer Vision  
Robotics  
Machine Learning  
Speech & Language  
Human Computer Inter.  
Privacy & Security  
Data Science

## Data types

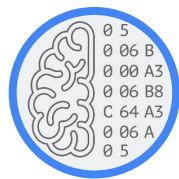
Text  
Speech and Audio  
Images  
Video  
...

## Application domains

Health and  
Life Sciences  
Energy  
Security  
Manufacturing and  
Industry 4.0  
Media and  
Entertainment  
Devices



+150 employees, +65 research projects and +120 publications per year



# Computation, Cognition & Language Group

**Boundaries of current AI system with respect to language:**

- Cross-lingual transfer for language technology
- Modelling **human cognitive abilities** that are underexposed, such as **creativity**

Text mining /  
analysis

Question  
Answering

Multilingual  
news aggregation

Content  
creation

[Image adapted from Gerd Altmann from pixabay.com]

# Why computational creativity?

- Recent trend has been to feed more and more data to learning methods
- This has led to impressive results in several tasks
- Also, awareness of limitations of these systems
- They are brittle, data-hungry, task-specific/narrow, and not learning in a flexible way as humans do, opaque
- All-in-all they lack many aspects of human intelligence

# Threats of current AI systems

- Brittleness
- Data-hungriness
- Bias
- Lack of explainability
- Narrowness

> The threats of the latter have been under-explored

# How narrowly defined AI systems threaten society

Work with Michele Loi, during research fellowship DSI Zurich

- Society is governed by processes that allow for diversity and innovation (e.g., market dynamics, natural evolution)
- A society which is highly informed by intelligent systems that are trained in a supervised fashion with narrowly defined objective functions will not exhibit the same exploration power as a system based on the individuals' judgments
- Fewer agents will be taking over the decision making that was previously done by many more individuals
- More and more impoverished data in training cycle

Filter bubbles and  
echo chambers

Bias in automatic  
candidate selection

(Loi & Van der Plas, SDS 2020) (Loi et al., ICCV 2020)





# Computational Creativity

Computational Creativity (CC) is a recent but burgeoning area of creativity research that brings together academics and practitioners from diverse disciplines, genres and modalities, to explore the potential of our machines to be creative in their own right (Veale et al., 2019)

Has a dedicated community and annual conference (ICCC)

Several systems have received public attention:

*The next Rembrandt*, GPT-3 screenwriting tools, Dabus (and the patent application for an AI-generated invention)



# Computational creativity

**Forecast:** The global computational creativity market size to grow from USD 204 million in 2018 to USD 685 million by 2023, at a CAGR of 27.4% during 2018–2023

Given this promising forecast, it is still an underexplored topic. Evaluation of creative systems is challenging

[Source: [www.researchandmarkets.com/](http://www.researchandmarkets.com/)

Machine Translation to grow only 15%, chatbots 28%]



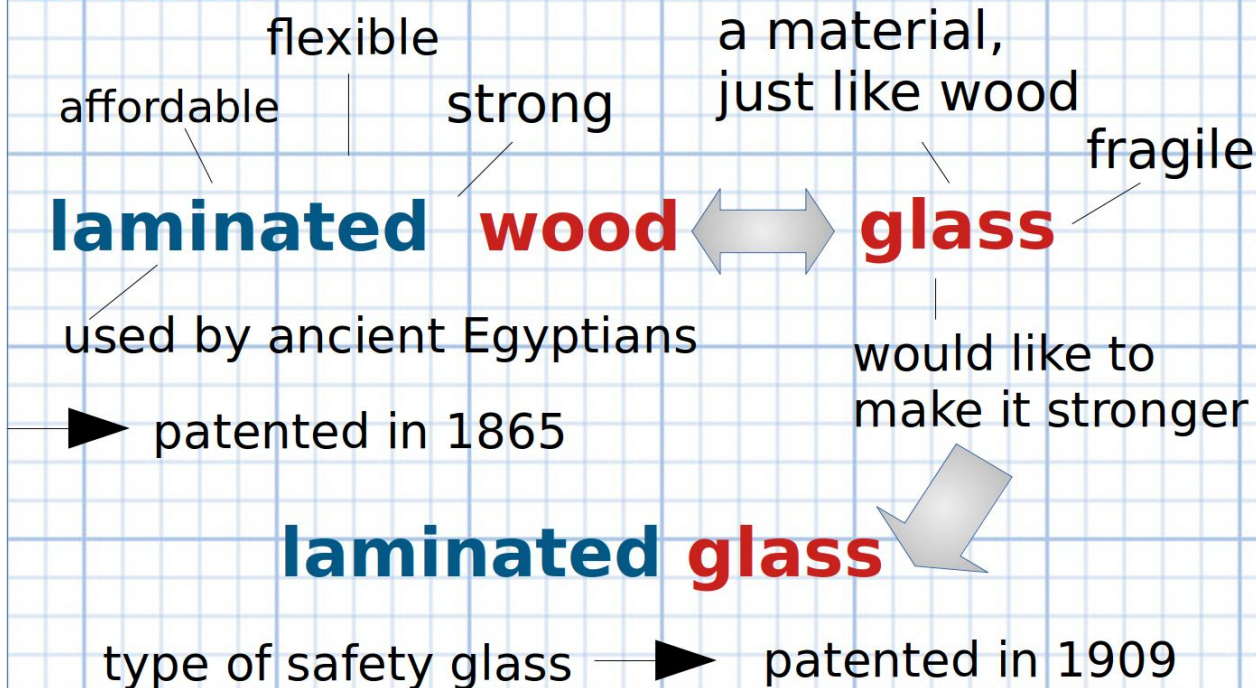
# Novel concept creation

Creative  
thinking follows  
certain patterns

Can be learned  
by machine

Need to process  
large amounts  
of text

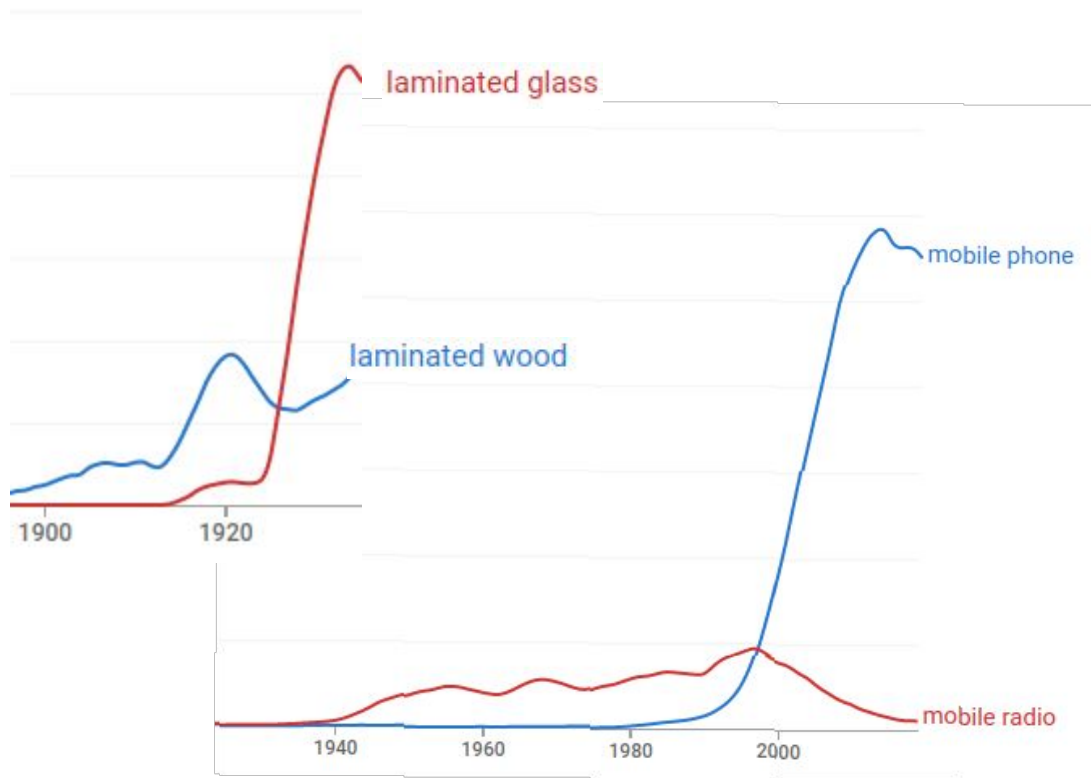
## EXAMPLE:





# Novel concept creation

We can trace the  
emergence and  
success of new  
ideas in texts



*Examples: vaccination certificate, flight schedule, stress management, PCR test, quarantine hotel...*

# Compounds

- The formation of a new lexeme by adjoining two or more lexemes (Bauer, 2003:40)
- Compounding is a very productive word formation process
  - English-speaking children can create novel compounds in spontaneous speech from a very young age (Clark, 1981)
- A very flexible word formation process (relation between lexemes is not specified)

# Implicit relations in noun-noun compounds

leather jacket	→	jacket <i>made of</i> leather ‘veste en cuir’
leather scissors	→	scissors <i>used to cut</i> leather ‘ciseaux pour le cuir’
kitchen knife	→	knife <i>used in the</i> kitchen ‘couteau de cuisine’
cheese knife	→	knife <i>used to cut</i> cheese ‘couteau à fromage’

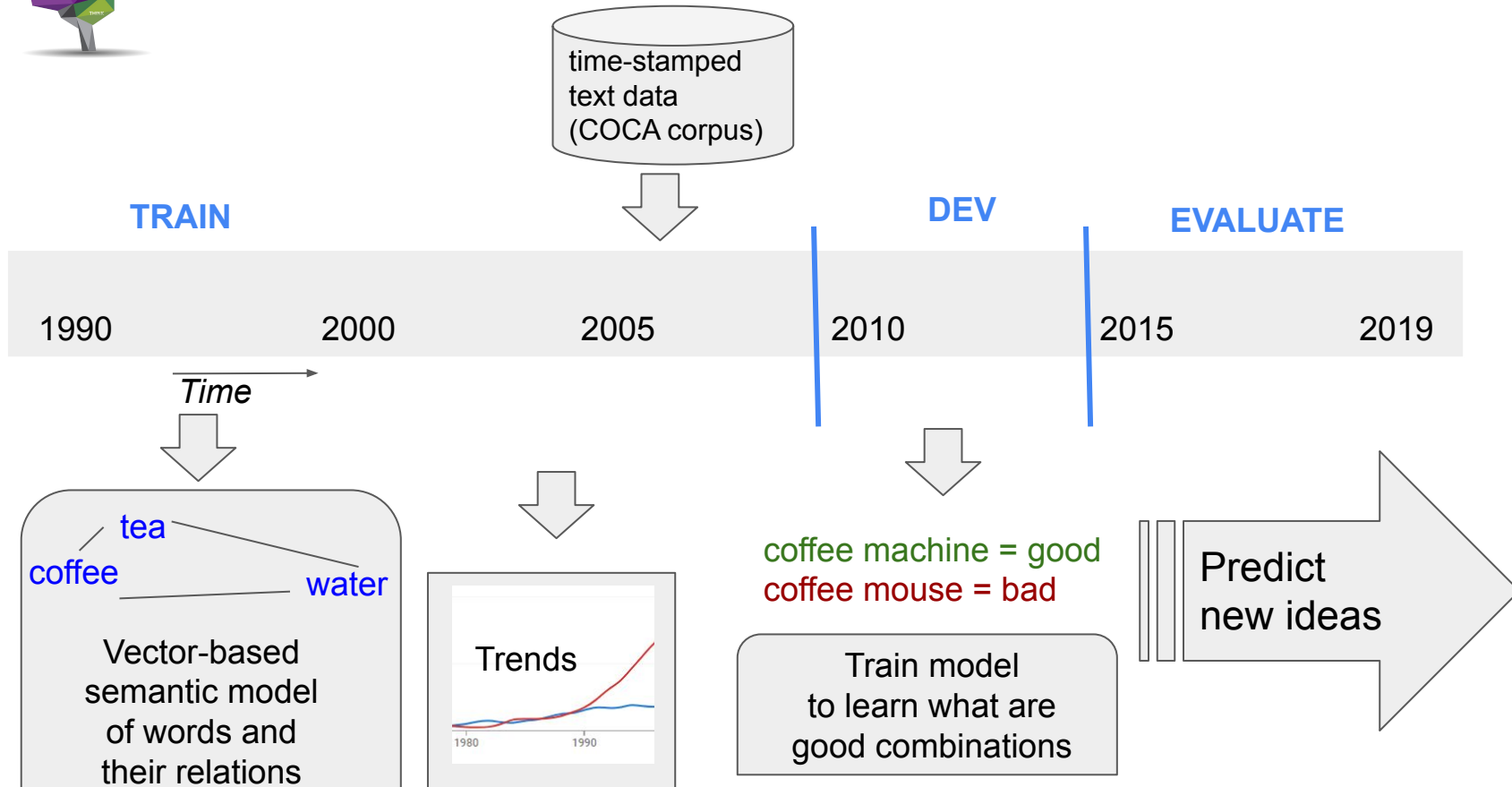


# Compounds as vehicles for creative thought

- Compounds allow us to do conceptual recombination
- Using known concepts in combination to create novel ones
- Very flexible, no need to specify the relation between the constituents



# A system for novel concept creation







# Example system output

Found in evaluation set  
2015-2019

Predicted by system

riesling sauce  
cheeseburger spread  
kevlar jacket  
waistband blouse  
boy food  
healthcare burden  
hashish store

brain sculpting  
knee-length glove  
light-emitting lamp  
melting cloud  
heron tooth  
porky dog  
mucous defect

vaccination law  
infection outbreak  
authentication method  
verification code

tilapia skin  
horseradish juice  
loot box  
pork burger

software school

township law  
evidence need  
toxicity datum  
lineup spot

assistance community  
summer trial

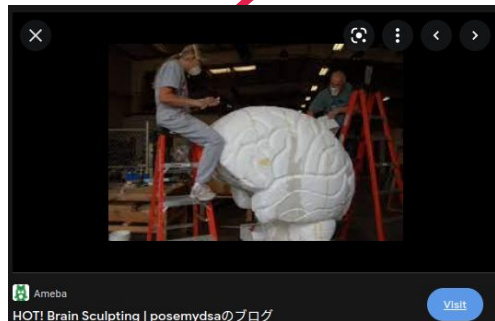
jail worker  
day candidate



# Example system output

Found in evaluation set  
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Predicted by system



brain sculpting

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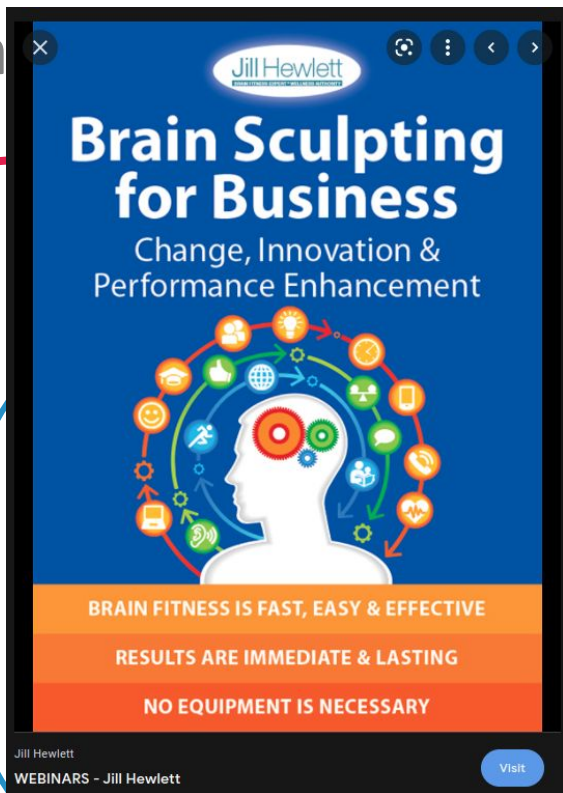
Exam

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Found in evaluation set  
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# Example system output

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# ICC'21: InnovAltor, a tool for business innovation



## Industry partners

Pharma company

Beverages and food company

## Informants & support

Educational publisher

Information science non-profit

ICC mentors

IDIAP technical staff

FoodHack



# InnovAltor, a tool for business innovation

## Disruptive innovations wipe out entire businesses

- Need to innovate fast, ahead of competition
- Out-of-the-box thinking is hard under time pressure
- Consumer needs are quickly changing



# Innovation is vital!

What if you had someone, who could:

- Read all your **internal data**
- Process all relevant **social media** content
- Discover **trends**, find new ideas in data
- **Predict trends for the future**
- **Present** everything in an orderly fashion
- And all of that by **tomorrow!**







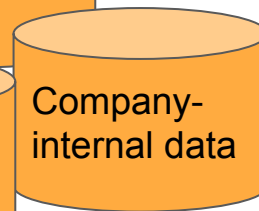
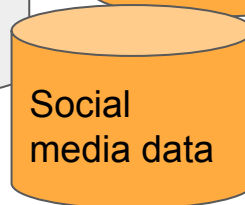
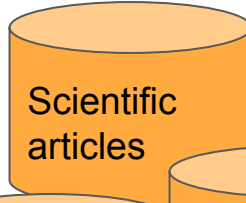
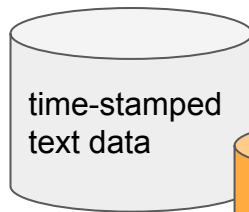
So let us use  
computational  
methods to do  
that!







# International Create Challenge '21

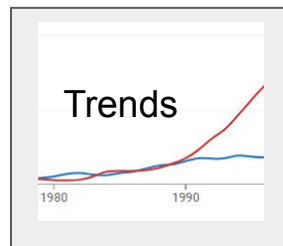
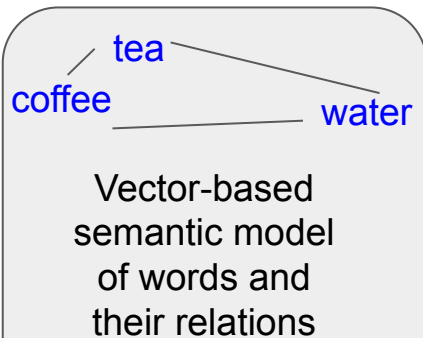


TRAIN

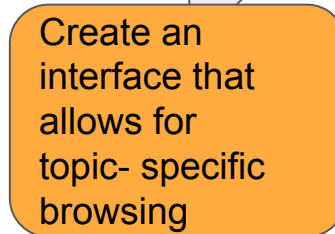
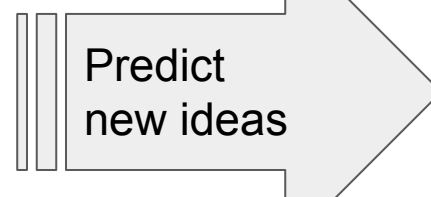
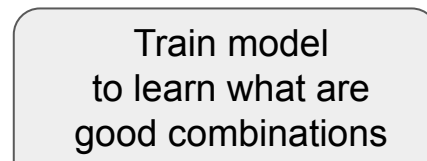
EVALUATE



Time →



coffee machine = good  
coffee mouse = bad





# C-LING : towards Creative systems with LINGuistic modelling

Project has **just been accepted** by the Swiss National Science Foundation (SNSF)

Plan to continue the work on novel concept generation while including **more structured knowledge, going from two-word concepts to more complex ideas.**

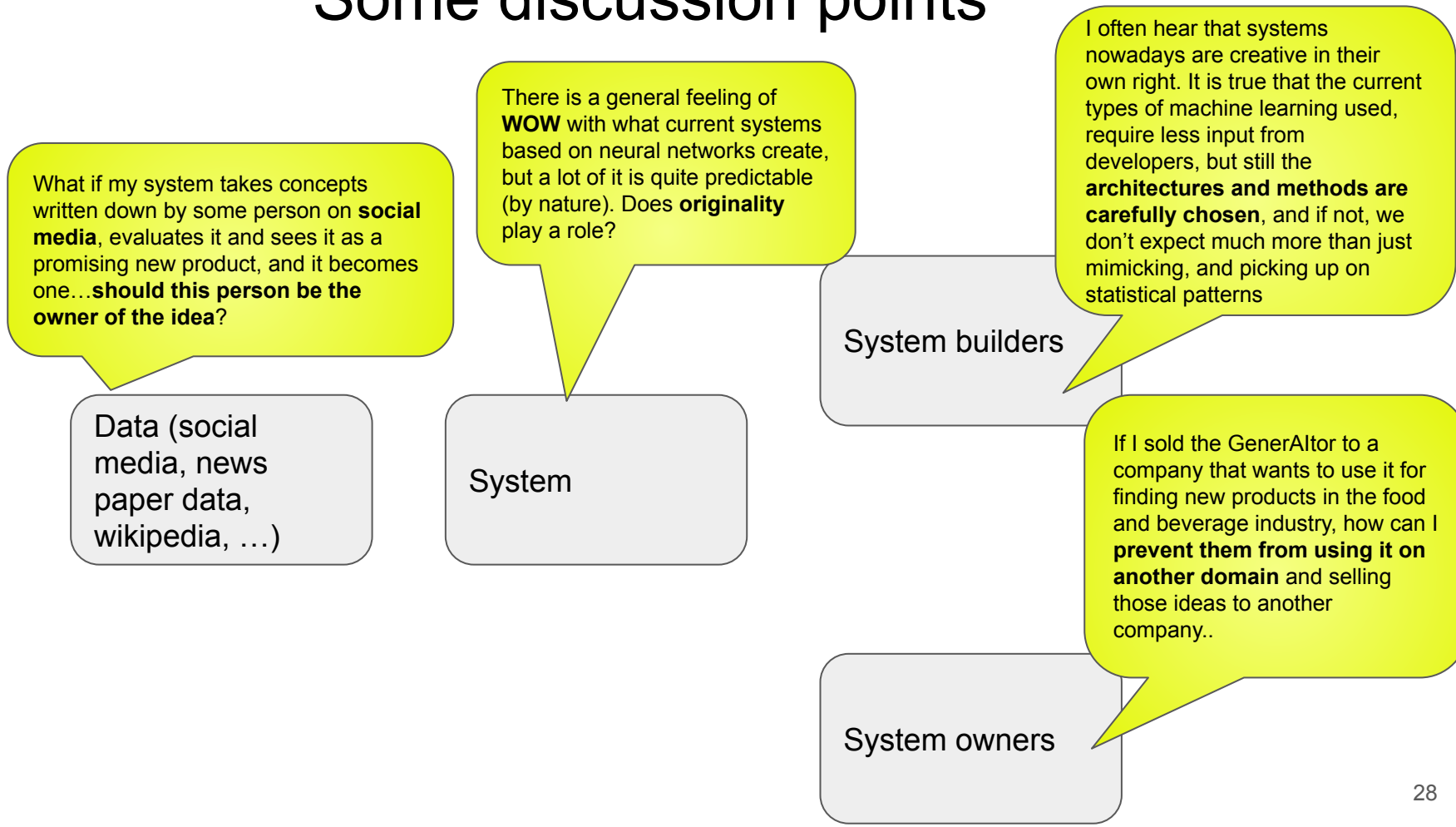
Also including **cross-domain and cross-lingual models**



# Leading into the discussion

- Computational Creativity is a young but expanding field
- Quite some attention from general public recently
- I have shown some first results of a system that generates new ideas/concepts
- We have worked on its application as a business innovation tool at the ICC last summer
- What are the legal implications? The issue of copyright was brought up during the ICC by the transfer office

# Some discussion points



Thanks for your attention!